

OJA + LCA + SPIKING = IMAGE COMPREHENSION

EQUATIONS GOVERNING OUR 2 MONTHS AT THE DARPA INNOVATION HOUSE IN ARLINGTON, VA

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Feed-forward weight adaptation:

$$\begin{aligned} \Delta Q(t) &\propto weight * \{[Oja] * [STDP] - decay\} \\ Q_{ij}(t + \Delta t) &+ = dwMax \{ \\ &\left[e^{\frac{-\Delta t}{\tau_{PL}}} X'_i(t) + A_X(t) - Q_{ij}(t) \left(e^{\frac{-\Delta t}{\tau_{DL}}} Y'_j(t) + A_Y(t) \right) \right] * \\ &\left[\lambda_P A_Y(t) \left(e^{\frac{-\Delta t}{\tau_P}} X_i(t) + A_X(t) \right) - \lambda_D A_X(t) \left(e^{\frac{-\Delta t}{\tau_D}} Y_j(t) + A_Y(t) \right) \right] - \\ &\alpha_{dec} Q_{ij}(t) \} \end{aligned} \quad (1)$$

Neuron adaptive threshold:

$$V_{thj} = dynVthRest_j + e^{\frac{-\Delta t}{\tau_{vth}}} (V_{thj} - dynVthRest_j) \quad (2)$$

where

$$dynVthRest[0] = V_{thRest}$$

$$dynVthRest_j + = \frac{\Delta t}{\tau_{THR}} \left[\frac{n_j(t)}{\tau_{LCA}} - f_o \right] \frac{V_{scale}}{f_o}$$

$$V_{scale} = V_{thRest} - V_{rest} > 0 ? V_{thRest} - V_{rest} : DEF_VSCALE$$

Neuron average firing rates:

$$n_j(t + \Delta t) = e^{\frac{-\Delta t}{\tau_{LCA}}} [A_j(t) + n_j(t)] \quad (3)$$

Lateral inhibition:

$$w_{jk}(t + \Delta t) + = \frac{\Delta t}{\tau_{INH}} \left[\frac{n_j(t)}{\tau_{LCA}} \frac{n_k(t)}{\tau_{LCA}} - f_o^2 \right] \frac{1}{f_o^2} \quad (4)$$